IS 4971 (2007): Recommendations for selection of industrial floor finishes [CED 5: Flooring, Wall Finishing and Roofing]

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(Reaffirmed 2012)

भारतीय मानक

औद्योगिक फ्लोर परिसज्जा के चयन की अनुशंसाएं

(पहला पुनरीक्षण)

Indian Standard

RECOMMENDATIONS FOR SELECTION OF INDUSTRIAL FLOOR FINISHES

(First Revision)

ICS 91.040.20; 91.060.30

BUREAU OF INDIAN STANDARDS
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Price Group 5

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Flooring, Wall Finishing and Roofing Sectional Committee had been approved by the Civil Engineering Division Council.

In the selection of industrial floor finishes, special care is required in view of the diversity of the requirements to be met with and the different characteristics of individual floor finishes. This standard has, therefore, been prepared to provide necessary guidance in the selection of floor finishes for industrial floors taking into consideration the factors influencing the floor finish and the properties of the individual floor finish.

The behaviour of a floor finish under a given set of conditions depends not only on the type of finish but also on its quality which in turn is dependent on both the materials and the workmanship. It is thus essential to select a suitable type of flooring for the purpose and also to insist on the use of the particular material conforming to the relevant Indian Standard and to lay the floor according to the relevant Indian Standard (*see* Annex A).

The recommendations given in this standard are concerned only with the selection of floor finishes, and their behaviour will, in turn, depend upon the strength and stability of the structural floor, the sub floor or the foundation. Movements due to bad design, overloading and the thermal expansion or shrinkage of the structure may cause failure of an otherwise satisfactory floor finish. Spillage of chemical solutions, acid, alkalies, etc, on the floor contribute towards the failure of a floor finish.

This standard was first published in 1968. In order to accommodate changes in technology and higher demands on product performance this standard is being revised with a view to modify some of the provisions already laid down and adding some new provisions for ceramic unglazed vitreous acid/alkali resistant tiles. These tiles are highly resistant to a host of acid/alkali and find applications in several chemical process industries employing acids/alkalies.

In the formulation of this standard, due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

RECOMMENDATIONS FOR SELECTION OF INDUSTRIAL FLOOR FINISHES

(First Revision)

1 SCOPE

This standard covers the selection of industrial floor finishes where the floor is subjected to heavy abrasion, impact, chemical action due to spillage of acid, alkalies and chemical solutions, etc. Guidance is also given for selection when the floor finish under special circumstances should be non-slippery, dustless, noiseless, non-sparking, anti-static, etc.

2 REFERENCES

The standards listed at Annex B contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated at Annex B.

3 NECESSARY INFORMATION

For efficient planning and execution of work, detailed data and information as given below shall be taken into account:

a) Purpose for which the floor is to be used;
b) Floor area to be covered;
c) Details of the sub-base or sub-floor;
d) Type of traffic that will be moving on the floor;
e) Live load on the floor:
   1) The area where such load occurs with its intensity; and
   2) Type of vehicle used.
f) Vibrations and impact, if any, on the floor with its magnitude;
g) Resistance to water and chemical action;
h) Resistance to temperatures;
j) Slope to be provided in the floor finish;
k) Treatment at corners and adjacent floor or walls; and
m) Specific requirements, if any, regarding the colour and appearance of the finished surface and of aggregates to be used.

4 TYPES OF FLOOR FINISHES

A finish for the floor of an industrial building may be generally selected out of the following types to suit the requirements of a particular case:

a) Plain concrete,
b) Granolithic concrete (with or without hardener),
c) Precast concrete tile,
d) Paving brick,
e) Fire clay brick,
f) Acid resistant brick,
g) Ceramic unglazed vitreous acid/alkali resistant tile,
h) Stone,
j) Steel or cast iron units,
k) Wooden block with lead lining,
m) Magnesium oxychloride,
n) Bitumen mastic,
p) Linoleum,
q) Rubber,
r) Flexible PVC sheets, and
s) Epoxy resin.

5 CONSIDERATIONS FOR SELECTION OF FLOOR FINISH

5.1 The important features that govern the selection of industrial floor finish are durability, incidence of loading, safety, resistance to chemical action, convenience of the user, appearance and overall economy. These requirements are covered under **5.2** to **5.5**. Table 1 gives in general a summary of the requirements of floor finishes for various industrial buildings.

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Table 1 Requirements of Floor Finishes for Various Industrial Buildings

(Clause 5.1)

Sl No.	Type of Building	Resistance to Abrasion	Resistance to Impact	Freedom from Slipperiness	Evenness or Smoothness	Warmth to Touch (Low Thermal Conductivity)	Appearance	Resistance to Attack by							Heat Resistance
								Water	Mineral Acids	Organic Acids	Alkalies	Solutions of Sulphates. Phosphates and Nitrates	Mineral Oil and Grease	Vegetable Oil and Fats	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
i)	Factories and workshops														
	a) Heavy industries	VI	VI	I	D	—	D	R	—	—	—	—	I	O	R
	b) Light industries	I	I	I	D	D	D	R	—	—	—	—	R	O	R
ii)	Loading and unloading platforms	VI	VI	I	R	D	D	I	—	—	—	—	R	R	R
iii)	Shops and offices	I	I	I	R	R	I	R	—	—	—	—	—	—	R
iv)	Food factories. factories processing meat. vegetables. animal or vegetable oil. breweries. beer cellars. etc	I	I	VI	D	D	R	I	D	VI	R	D	R	VI	I
v)	Factories using process involving sugar solutions. etc	I	R	I	D	D	R	I	R	I	D	D	D	D	R
vi)	Dairies	VI	I	VI	R	D	R	VI	D	I	—	—	—	R	R
vii)	Factories handling or using salts. salt solutions. fertilizers. etc	I	I	I	R	D	D	I	VI	—	I	VI	D	D	R
viii)	Chemical factories (miscellaneous). chemical laboratories and explosives manufacturing factories	VI	VI	I	R	R	D	VI	VI	VI	VI	VI	R	R	O

VI = Very Important
I = Important
D = Desirable
— = Not usually required
R = Required to some degree
O = Variable — very important to not required sometimes

5.2 Durability

5.2.1 *Wear*

The nature of mechanical wear that a floor has to resist varies considerably. For general consideration the type of wear may be classified as below:

Type of Wear	*Examples*
a) Very severe abrasion together with heavy impact	Heavy engineering workshops and places where milk cans are being handled in diaries
b) Very severe abrasion	Places where steel — Tyred trucks constantly move
c) Severe abrasion	Floor having traffic of more than 2 000 persons a day in definite traffic lanes

5.2.2 *Impact*

Consideration should be given for impact as many flooring materials that will stand abrasion may suffer rapid damage under impact.

5.2.3 *Load Carrying Capacity*

Depending on the nature of loading and type of traffic, such as foot, rubber tyred, metal wheeled, etc, the flooring shall be selected to withstand the service condition.

5.3 Safety

5.3.1 *Safety Against Falls*

It should be ensured that the floor finish does not contribute to accidents by falls. Factors causing accidents by falls are slipperiness, uneven wear, pot-holing, indentation or splintering of surfaces, cracking or lifting of the floor, etc.

5.3.2 *Resistance to High Temperature and Fire*

In industrial structures, high temperatures occur without spread of fire. Floor finishes do not by themselves add to fire risk, provided that the floor structure has adequate resistance to fire. In certain special circumstances, however, there may be risks arising from the usage of the floor. For example, oil or other flammable liquids spilled on the floor will lead to greater fire risks with floors which are absorbent or themselves combustible, such as timber or bitumen, than with inert dense materials, such as concrete or tiles.

5.3.3 *Spark Resistance*

In factories or stores where explosives and substances liable to cause explosions are being handled, sparks caused by friction on a floor surface may cause fire or explosion, therefore, it is essential to use non-sparking floor finishes, such as rubber or special grade of bitumen mastic or magnesium oxychloride composition. A lead lining may be provided over the base concrete or wooden flooring where explosives are being stored.

5.3.3.1 It may sometimes be necessary, in order to avoid risk of static electricity causing sparking, to use a floor which conducts electricity causing sparking, to use a floor which conducts electricity and thus prevents the accumulation of static electric charges. Floor topping using concrete with metallic aggregate or steel or cast iron grids embedded in concrete may be used for such work.

5.4 Resistance to Chemicals and Water

The spillage or splashing of chemical solutions, acids and alkalies or chemical powders may cause corrosion, deterioration, induce slipperiness or give rise to any risk to health or risk of fire or explosion. The possibility of wetting or flooding the floor with water should also be taken into account.

5.5 Appearance

In industrial buildings appearance is not an important factor in the selection of the floor finish but, the floor should be capable of being kept clean and should be free from cracks and crevices. Having satisfied the basic requirements the floor with a better appearance is preferable for an industrial building.

5.6 Resistance to Frost

In cold storage applications where temperatures are below freezing point, there should not be any seepage of water and the water absorption of the flooring should be very low or near zero. Water absorbed by the floor will expand upon freezing leading to build up of stresses in the floor and may eventually lead to floor failure.

5.7 Easy Maintenance and Repair

The floor finishing material should be such that it can be maintained with ease using conventional methods and repairs to damaged areas, if any, can be carried out with ease to restore the flooring back to the original condition.

6 PROPERTIES OF FLOOR FINISHES

Properties of floor finishes for industrial buildings are given in Table 2.

6.1 Cement Concrete Finishes

6.1.1 *Plain Cement Concrete*

For industrial floors cement concrete is used for a wide variety of conditions in the *in-situ* form. Portland cement concrete is resistant to a wide variety of chemicals, including mineral oils and greases but is slowly attacked by acids, vegetable oils, fats and sugar solutions.

Table 2 Properties of Floor Finishes

(*Clause* 6)

Sl No.	Type of Finish	Resistance to Abrasion	Resistance to Impact	Freedom from Slipperiness	Evenness or Smoothness	Warmth to Touch (Low Thermal Conductivity)	Appearance	Resistance to Attack by								Heat Resistance
								Water	Mineral Acids		Organic Acids	Alkalies	Solutions of Sulphates, Phosphates and Nitrates	Mineral Oil and Grease	Veg Oil and Fats	
									Weak	Strong						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
i)	Portland cement															
	a) In-situ	VG-P	G-P	VG	VG-P	P	G	VG	P	VP	F-P	G	P-VP	G	P	G
	b) Pre-cast	VG-G	G-F	VG	VG-P	P	G	VG	P	VP	F-P	G	P-VP	G	P	G
ii)	Steel tiles or grids embedded in concrete	VG	VG	G	P	P	F	VG-F	P	VP	F-P	G	P-VP	G	P	G
iii)	Cast iron tiles	VG	VG	F	F-P	P	F	G-F	P	VP	G	F	F-P	VG	G	VG
iv)	Natural stones	VG-F	VG-F	G-F	G-P	P	G-F	G	G-P	F-VP	G	G-F	F	G	G	G
v)	Heavy duty burnt clay brick/paving brick	G	G	VG	F	P	F	VG	G	G-P	G	F-VP	G-P	G	G	G
vi)	Fire brick	G	G-F	VG	F	P	F	VG	VG	G	G	P	G-P	G	G	VG
vii)	Acid resistant brick	VG	VG	VG	F	P	G	VG	VG	G	G	P	G	G	G	VG
viii)	Acid/Alkali-resistant unglazed ceramic tiles	VG	VG	VG	VG	P	VG	VG	VG	VG	VG	VG	VG	VG	VG	VG
ix)	Magnesium oxy chloride cement	VG	VG	G	VG	G	VG	P	P	VP	G	G	G	VG	VG	G
x)	Bituminous mastics	G-F	G	G	G	F	F	VG	F-P	VP	P	G	G	F	F	P
xi)	Linoleum	F	G	VG	VG	VG	VG	G	G	G-P	G	P	G	G	G	F
xii)	Rubber sheets/tiles	F	G	VG	VG	F	VG	G	G-P	G-VP	F	G	G	P	G	P
xiii)	PVC — asbestos tiles	F	G	VG	G	G	VG	VG	F	F	VG	F	VG	VG	VG	VG
xiv)	Epoxy resins	VG	G	G	F	G	G	VG	G	G-F	G	G	VG	VG	VG	G
xv)	Polyester resins	G	G	G	F	G	G	VG	G	G-F	G	G	VG	G	G	G

VG = Very Good
G = Good
F = Fair
P = Poor
VP = Very Poor
G-P = Denotes a variation with the quality of the material or with the severity of the conditions

Frequent cleaning reduces the attack, but prolonged exposure will bring about a gradual deterioration of the cement concrete flooring.

6.1.2 *Granolithic Concrete*

The granolithic concrete when properly compacted and finished, is hard wearing, resists impact and is resistant to alkalies and mineral oils. On the other hand, it is hard to the feet, cold, noisy and susceptible to chemical attack by many chemical agents including acids, sulphates, animal and vegetable oils, fats and sugar.

6.1.3 *Precast Concrete Tile*

Concrete tiles have good resistance to wear and chemical attack but cannot withstand heavy impact. Where good appearance and cleanliness are required for the flooring, concrete tiles may be selected.

6.2 Brick and Tile Finishes

These have good resistance to wear and impact.

6.2.1 *Paving Brick*

Paving bricks conforming to IS 3583 may be used for heavy duty and industrial floors, loading and unloading platforms where the floor is subjected to heavy wear and tear.

6.2.2 *Fireclay Brick*

In situations where high temperatures are to be met with, such as those around metallurgical furnaces fire clay bricks may be laid in fire clay mortar.

6.2.3 *Acid-Resistant Brick*

The acid-resistant bricks conforming to IS 4860 have good resistance to all acids except hydrofluoric acid and perchloric acid, and other chemicals. They are suitable for floorings subject to acid attack and abrasion.

6.2.4 *Ceramic Unglazed Vitreous Acid/Alkali-Resistant Tile*

These tiles conforming to IS 4457 have good resistance to acids and are suitable for floorings subject to acid attack, impact and abrasion. Further, the surface of the tiles can be provided with structured self-design to impart anti-skid properties. The vast range of designs and effects available gives necessary aesthetic appeal to the floor. The vitreous nature of these tiles also makes them stain and frost resistant making them suitable for low temperature applications. They can also provide sufficient impact strength depending on the thickness of the tile. The high surface hardness also ensures that concentrated point loads do not cause any indentation or damage to the floor.

6.3 Stone Flooring

6.3.1 The types of stones useful for flooring are granite, basalt, quartzite and sandstone.

6.3.1.1 Granite is very hard and resistant to wear by abrasion or impact, and to attack by chemical agents. It is readily cleaned and if kept clean it is non-slippery till unworn; after considerable wear, it may become smooth and slippery and mechanical roughening may be necessary. It is used in thick slabs of various sizes depending upon the conditions of use. Granite slabs are suitable for the flooring of loading and unloading platforms in workshops, godowns, etc.

6.3.1.2 Basalt flooring will be suitable for heavy engineering factories and garages as it may withstand impact and wear and where the floor need not be too smooth and even.

6.3.1.3 Quartzite slabs are used mainly for entrance halls or where a decorative appearance combined with good wearing properties under heavy foot traffic is required. The stone is easy to clean and does not become slippery.

6.3.1.4 Sandstones (*see* IS 3622) of suitable variety and thickness may be used for light duty flooring.

6.4 Steel and Cast Iron Floor Finish

Metal floor finishes are used where severe wearing conditions are encountered. Several types of steel or cast iron units are used for heavy duty flooring. This type of finish includes:

a) open metal grids embedded in granolithic concrete or in bitumen mastic,
b) solid tiles or solid plates, and
c) open metal grid suspended floors.

6.4.1 Open metal grids embedded in granolithic concrete are suitable for loading platforms subject to impact and wear caused by movement of trolleys with iron wheels, under wet or greasy conditions as in the case where bottled milk are handled. Steel tiles with a smaller proportion of open space than the grids embedded in granolithic concrete are suitable for situations subjected to heavy abrasion and impact. The open metal grids and steel tiles tend to become slippery when oily and to corrode when wet.

6.4.2 Solid faced metal tiles (usually made of cast iron) are highly resistant to wear and impact and to the action of oils, fats, salts and alkalies provided the joints are also filled with appropriate chemical resistant material. The plain surface types are liable to become slippery if wet or even when dry if polished by wear, and hence special type with a patterned surface shall be used under these conditions. The solid metal tiles are particularly

useful, on loading bays where there is heavy trucking and in dairies where a high standard of cleanliness combined with high resistance to wear and chemical attack is required.

6.4.3 Steel or cast iron grid suspended floors are used for elevated platforms or walkways around large machinery. Floors on which liquids or solids are continuously being spilled may be made of supported steel grids with suitable channels beneath, from which the spilled material may be drained or recovered.

6.5 Wooden Block With Lead Lining

This provides a non-sparking floor finish and is suitable for floors where explosives are stored.

6.6 Magnesium Oxychloride

This flooring mix gives a fairly strong and durable floor with good appearance. However, the flooring is affected by continued exposure to water, acids and salt solutions. Too wet a mix with excess of magnesium chloride results in sweating of the floor surface. Mineral oils, greases, vegetable oils, milk products and milk alkalies do not affect the floor.

6.7 Bitumen Mastic Flooring

Bitumen mastic flooring has been considered suitable for use in industrial buildings, storage houses, etc, because of its resiliency, wearing quality and ease of maintenance. Bitumen mastic flooring (*see* IS 1196) is dustless, odourless, jointless and impervious to the transmission of moisture, either in liquid or vapour form. The flooring may be easily cleaned, quite under traffic and resilient. Bitumen mastic flooring is also durable. While it may carry heavy loads, application of concentrated point load may cause indentation. In selecting bitumen mastic flooring consideration shall be given to the anticipated service conditions, particularly the type of traffic and possible contact with oils, acids and the like. The surface of bitumen mastic flooring is liable to become slowly softened by prolonged contact with greases, fats and oils. Contamination with such materials shall be avoided.

6.8 Linoleum Flooring

Linoleum provides clean, dust free and resilient flooring. In light industry, such as in electronic industry, linoleum flooring may be used as the risk of damage by cutting to which linoleum is vulnerable is small. If linoleum gets wet, it expands mildews and eventually rots.

6.9 Rubber Flooring

The flooring is resilient and noiseless. The flooring is suitable for electronic industry, computer rooms, etc.

6.10 Flexible PVC Flooring

The PVC flooring provides a clean, dust free, and resilient flooring. The flooring may be easily cleaned with a wet cloth, as dirt and grime do not penetrate the surface.

6.11 Epoxy Resin Floor Topping

The use of epoxy resin for industrial floor toppings is characterized by its exceptional physical and chemical properties, such as chemical resistance, hardness, abrasion resistance, compressive, impact and structural strengths, dimensional stability and adhesion to concrete, metals and other surfaces. This is suitable for use on industrial floors, such as in chemicals plants manufacturing fertilizers, pharmaceuticals, acids, solvents, etc; in dairies, tanneries, breweries, garages, service stations, warehouses, metal plating and pickling areas.

7 RECOMMENDATIONS FOR FLOOR FINISH FOR INDUSTRIAL BUILDINGS

Recommendations for floor finishes for industrial buildings are given in Table 3.

7.1 Floors for Heavy Engineering Factories Workshops and Garages

Floors in heavy engineering factories, workshops and garages shall be resistant to impact, abrasion, and attack by lubricating oils. The epoxy resin floor topping is suitable for heavy industrial floors. The extent to which the floors will be subjected to heavy wear or impact will often vary widely in different parts, and since the more resistant type of finish are more expensive it is advisable to ascertain as far as possible, before laying the finishes, where trucking gangways or processes involving impact will be located and to provide accordingly. Steel or cast iron tiles or plates, embedded in granolithic concrete may be used for areas of heavy abrasion by steel-tyred trucks or where a high resistance to impact is required. High thickness tiles such as 15 mm or 20 mm thick vitrified ceramic tiles are also suitable for high impact resistance applications.

7.1.1 Granolithic concrete with suitable materials and good workmanship will provide in light industrial workshops and garages a floor finish of reasonable durability. Special aggregates and metallic floor hardeners may be added to the granolithic concrete where impact and wear is expected. Vitrified ceramic unglazed tiles of thickness 12 mm and 15 mm are extremely durable and can be used for light industrial workshop floors.

7.2 Loading and Unloading Platforms

7.2.1 The requirements for platforms and industrial

Table 3 Recommended Floor Finishes for Industrial Buildings

(Clause 7)

Sl No.	Type of Building	Situation and Conditions Met With	Recommended Floor Finish	Jointing and Bedding Mortar
(1)	(2)	(3)	(4)	(5)
i)	Floor for heavy engineering factories, workshops and garages	a) Conditions normal	Granolithic concrete or paving bricks	—
		b) Heavy impact or wear	Epoxy resin floor topping and high thickness (15-20 mm) vitreous unglazed ceramic tiles	—
		c) Places where spillage is expected to contain lubricating oils	Epoxy resin floor topping or vitreous unglazed ceramic tiles	—
		d) Floors subjected to heavy abrasion by steel tyred trucks	Steel or cast iron tiles or plates embedded in granolithic concrete	—
ii)	Loading and uploading platforms	a) Platforms involving normal loading conditions	Granolithic concrete or granite slabs or paving bricks or vitreous unglazed ceramic tiles	—
		b) Platforms involving heavy impact	Steel tiles or anchor plates or metal grids embedded in granolithic concrete	—
iii)	Food factories, factories processing meat, animal or vegetable oils, breweries beer cellars, etc	a) Floors subjected to the action of lubricating oils combined with the action of hot water	Epoxy resin floor topping or paving bricks or ceramic unglazed vitreous acid-resistant tiles	—
		b) Abrasion resistance not severe	Magnesium oxychloride flooring	—
		c) Severe abrasion	Epoxy resin floor topping or paving bricks	—
iv)	Factories using processes involving sugar solution and weak acids	a) Places where abrasion and impact are not excessive	Epoxy resin floor topping or unglazed vitreous acid/alkali-resistant tiles or acid-resistant bricks	—
		b) Places where hot sugar solution or molasses are used	Unglazed vitreous acid/alkali-resistant tile or acid-resistant bricks	Tiles or bricks shall be bedded and jointed in acid resistant mortar
v)	Factories handling or using salts or salt solutions and fertilizers	a) Places where common salt is the main constituent of spillage	Granolithic concrete or bitumen mastic or vitreous acid/alkali-resistant unglazed ceramic tile	—
		b) Spillage containing any type of salts or fertilizers	Epoxy resin floor topping or ceramic unglazed vitreous acid/alkali-resistant tiles or acid-resistant bricks	—

loading bays are primarily high resistance to impact and abrasion and non-slipperiness.

7.2.2 Steel tiles or 'anchor-plates' or metal grids embedded in granolithic concrete are suitable for loading and unloading platforms subjected to heavy impact. Granite stone slabs or paving bricks when properly embedded are suitable for platform flooring. Granolithic concrete may also be used for flooring of normal loading platforms not subjected to heavy impact.

7.3 Food Factories, Factories Processing Meat, Vegetables, Animal or Vegetable Oils, Breweries, Beer Cellars, etc

There are many factories making soap, candles, and lubricating oils, in which the floors are subjected to the action of animal or vegetable oils or fats due to spillage combined with abrasion. The epoxy resin floor topping is suitable in such situations. Magnesium oxychloride flooring or heavy duty brick flooring may also be adopted. The very low water absorption of ceramic unglazed vitrified tiles makes them ideally suited for applications where hygiene is of paramount importance, such as in food processing and pharmaceutical industries. The low water absorption of these tiles makes them resistant to growth of algae or bacteria or other forms of organic growth. The joints between such tiles can be filled with epoxy-based grouts to make the floor completely impervious.

7.4 Factories Using Processes Involving Sugar Solutions and Weak Acids

7.4.1 In factories processing fruits or vegetables or using sugar syrups, as for example, preserve, canning; pickle, fruit drink, sweet or sugar factories, the floors are subject to chemical action by fruit acids, vinegar and sugar syrup and often to impact and abrasion by movement of casks and by trucking.

7.4.2 Unglazed vitreous acid-resistant tiles or acid-resistant bricks properly bedded and jointed with chemical-resistant mortar provide a satisfactory floor for such situations. Epoxy resin floor topping is also suitable for such situations.

7.5 Factories Handling or Using Salts or Salt Solutions and Fertilizers

7.5.1 The risk of deterioration of floors upon which salts or salt solutions may be spilled as in tanning, bacon curing, or chemical factories depends upon the nature of the salts. Chlorides, as in common salt when spilled are not very harmful to the floor finishes. Bitumen mastic flooring is suitable for such situations because of its impermeability and resistance to chemical action. Granolithic concrete may also be used. Ceramic unglazed vitreous acid/alkali-resistant tiles can also be used for this application.

7.5.2 Nitrates, sulphates and phosphates which are widely handled in the fertilizer industry, may lead to rapid deterioration of the cement concrete floor. Epoxy resin floor topping or floor paved with ceramic unglazed vitreous acid-resistant tiles or acid-resistant bricks will be suitable in such situations.

7.6 Dairy Floors

In a dairy the requirements of the flooring differ in different areas. A careful study and understanding of the conditions met with in various processing areas of a dairy shall have to be taken into account in order to select a finish suitable for a particular area in a dairy. The types of floor finish found in general to be most satisfactory for use in different areas of a dairy are given in Table 4.

8 BEDDING AND JOINTING MATERIALS

8.1 Appropriate choice of bedding and jointing materials is essential if the risk of defective floors or premature failure is to be avoided, even when the main flooring material, that is, block, slab or tile, is of a type which would otherwise be satisfactory.

8.1.1 The bedding and jointing material shall adhere properly to the base on which the finish is laid, and to the finishing units. It shall be durable in itself and shall resist chemical attack to which the floor may be exposed. The bedding is also sometimes required to stop moisture penetrating the structural floor from the surface. Other points, besides these shall, however be given consideration in deciding upon the suitability of jointing and bedding materials for specific conditions of exposure. The various materials used for bedding and jointing are given in Table 5 and their resistance to deterioration is indicated.

Table 4 Recommended Surface Finishes for Dairy Floors

(*Clause* 7.6)

Sl No.	Situation	Condition of Wear	Type of Finish	Jointing and Bedding Mortar
(1)	(2)	(3)	(4)	(5)
i)	Loading platforms for milk cans and paths for rolling of cans	Most severe conditions of wear with repeated heavy impact	Steel tiles or steel plates or open metal grids embedded in granolithic concrete	—
ii)	Loading platforms for trucks carrying milk bottles	Heavy abrasion but conditions not as severe as on can platforms	Steel tiles or steel plates or open metal grids embedded in granolithic concrete or bitumen mastic; paving bricks, vitreous unglazed ceramic tiles of high thickness such as 15 or 20 mm	—
iii)	Processing and bottling area	Subject to continuously wet conditions and exposed to milk fats, sugar acids and various cleaning agents. Also subject to considerable wear	Paving bricks or stone flooring or textured (self-design) vitreous unglazed ceramic tile	The satisfactory jointing and bedding material is chemical-resistant mortar of resin type
iv)	Parts of dairy not covered by item I, II and III	Conditions not so critical	a) Granolithic concrete b) Bitumen mastic with hard granite aggregate c) Ceramic unglazed vitreous acid/ alkali-resistant tiles	—
v)	Cold storage rooms	Moderate	Ceramic unglazed vitreous acid/ alkali-resistant tiles or acid-resistant bricks or paving bricks	The tiles or bricks should be embedded in cement mortar with joints filled with resin mortar

Table 5 Properties of Bedding and Jointing Materials for Floors

(*Clause* 8.1.1)

Sl No.	Type of Material	Manner of Use	Hardness	Adhesion to Smooth Surface	Resistance to Wear	Resistance to Attack by								Resistance to Temperature
						Water	Mineral Acids		Organic Acids	Alkalies	Solutions of Suphate. Phosphates and Nitrated Mineral Oil and Greases		Vegetable Oils and Fats	
							Weak	Strong						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
i)	Portland cement mortar	1: 3	Hard	F	F	VG	VP	VP	F-P	VG	P	G	P	G
ii)	Bituminous mastics	Hot, as supplied	Plastic	G	G-F	VG	F	P	P	G	G	P	P	P
iii)	Rubber latex cement mortar	Rubber latex with Portland cement	Resilient	VG	G	G	G-P	P	P	G	F	F	F	P
iv)	Chemical-resistant silicate-type mortars	Silicate solution and fillers	Hard and Rather Brittle	G	F	P	VG	VG	VG	P	G	G	G	G
v)	Chemical-resistant sulphur-type mortar	Sulphur and fillers. Dry mortar to be melted before use	Hard	G	G	VG	G	G-F	G	G	G	G	F	VG
vi)	Chemical-resistant resin-type mortars	Resin syrup, fillers and hardeners												
	a) Epoxy resin mortar or furane resin mortar	—	Hard and Tough	VG	VG	VG	VG	G-F	G	VG	G	G	G	VG
	b) Cashew nut shell liquid resin	do	do	VG	VG	VG	VG	G-F	P	G	VG	P	P	VG-P
	c) Other resin mortars	do	do	G	G	G	G	F	G-P	G-P	G-F	G	G	—

VG = Very Good F = Fair VP = Very Poor

G = Good P = Poor

8.1.2 It may not always be necessary to use the same material for bedding and for finishing the joints. Where the spillage of harmful material is not likely to be appreciable or where the floor may be cleaned down frequently, it may be sufficient to point the joints with the chemical-resistant mortar and to use cement mortar for bedding. It may also sometimes be an advantage to bed the units in a bituminous waterproof compound and to point the joints with a chemical-resistant mortar. In general, however, the use of one type of mortar with very thin joints requiring no pointing should be preferred even if separate bitumen or other waterproof layer is laid before bedding and jointing the tiles.

ANNEX A

(*Foreword*)

RELEVANT INDIAN STANDARD FOR LAYING OF FLOORING

IS No.	*Title*
658 : 1982	Code of practice for magnesium oxychloride composition floors (*second revision*)
1196 : 1978	Code of practice for laying bitumen mastic flooring (*second revision*)
1197 : 1970	Code of practice for laying of rubber floors (*first revision*)
1198 : 1982	Code of practice for laying, fixing and maintenance of linoleum floors (*first revision*)
1443 : 1972	Code of practice for laying and finishing of cement concrete flooring tiles (*first revision*)
2114 : 1984	Code of practice for laying *in-situ* terrazzo floor finish (*first revision*)
2571 : 1970	Code of practice for laying *in-situ* cement concrete flooring (*first revision*)
4441 : 1980	Code of practice for use of silicate type chemical resistant mortars (*first revision*)
4442 : 1980	Code of practice for use of sulphur type chemical resistant mortars (*first revision*)
4443 : 1980	Code of practice for use of resin type chemical resistant mortars (*first revision*)
4631 : 1986	Code of practice for laying of epoxy resin floor toppings (*first revision*)
5318 : 1969	Code of practice for laying of flexible PVC sheet and tile flooring
5491 : 1969	Code of practice for laying of *in-situ* granolithic concrete flooring topping
5766 : 1970	Code of practice for laying of burnt clay brick flooring
13074 : 1991	Code of practice for laying of bitumen mastic flooring for industries handling LPG and other light hydrocarbon products
15193 : 2002	Laying of pitch-mastic flooring for industries handling heavy hydrocoarbon products like kerosene, diesel and furnace oil — Code of practice

ANNEX B

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1196 : 1978	Code of practice for laying bitumen mastic flooring (*second revision*)
3583 : 1988	Specification for burnt clay paving bricks (*second revision*)
3622 : 1977	Specification for sandstone (slabs and tiles) (*first revision*)
4457 : 2007	Specification for ceramic unglazed vitreous acid resisting tile (*second revision*)
4860 : 1968	Specification for acid-resistant bricks

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